On the Coördination of the Various Methods of Expressing Thought as Applied to the System of Public School Instruction. By Lewis M. Haupt, C. E., Prof. of Civil Engineering, University of Pennsylvania.

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Language, in its most general signification, is any medium by which thoughts or ideas may be conveyed from one person to another, and the avenues through which it affects the human intelligence are the senses.

In transmitting an idea, the senses may be called into action either singly or in combination. Thus speaking involves the sense of hearing, for a person born deaf must of necessity be dumb also. We may therefore regard the vocal organs and the ear as complementary functions for the transmission and reception of audible intelligence. These may be supplemented or entirely supplanted in their absence by the hand and eye, also complementary. In both of these cases the vocal organs and hand are the media of, while the ear and eye are the guides to, the proper form of expression.

From this it follows that there may be two distinct forms of language, namely, *Oral*, or that proceeding from the mouth, as in speaking, and *Graphical*, or that produced by the hand, as in writing, drawing, and printing. *Oral* language appeals to the ear of the recipient, *Graphical*, to the eye, for the correct interpretation of the idea intended to be expressed. If the same meaning be given to a combination of words, by the recipient, as was intended by the originator of an idea, then the result will be an identity of thought and a mutual understanding resulting in harmony. But as words have many meanings, the same words may produce very different impressions upon different minds even under similar circumstances, hence, to avoid misunderstanding, with its attendant confusion or discord, it is desirable to employ, if possible, a less ambiguous form of language.

A single instance will serve to illustrate this proposition.

Let the name of a substance, as *iron*, be mentioned. An audience composed of physicists, chemists, engineers, artisans, artists and literati immediately begin to think of some of its characteristic properties.

While the man of letters may regard it as a rigid, incombustible substance, the chemist considers it flexible and burns it with great brilliancy; while the prisoner may look upon it as an obstruction, the electrician makes it a channel of communication. The agriculturalist may use it as an implement of peace, whilst the soldier will make it an instrument of war. With the civil or mechanical engineer it is an important material of *construction*, whilst with the military engineer it is an engine of destruction.

"The meaning of such a word is like the rainbow: everybody sees a different one, yet all maintain it to be the same."

It is thus with many words in our vocabulary, and hence arise sectarianisms, difficulties, violations of contracts and tedious litigation to determine the sense of some particular form of expression.

It is not necessary to dilate further upon the ambiguities of language, nor of the many serious and sometimes comical mistakes resulting from

them, but a few suggestions may not be out of place as to the necessity for more extended instruction in that branch of it which relates to the expression of ideas by graphical representations and especially by drawings.

It is a matter of primary importance to the progress of civilization that every avenue for the interchange of thought should be unobstructed, that there may be an unification of purpose and action; and secondarily, that the media used to convey such thought should be unambiguous and of general application. Now, since all ideas must have for their subject matter things physical or metaphysical, it follows that there may be a different form of language used in giving expression to each. As most physical conceptions treat of tangible objects, having form, and as such form or line of apparent contour is the first characteristic observed by the eye, and is more or less familiar to all persons living within the habitat or range of the object, it is natural that this form, more or less conventionalized or symbolized, should have been used to represent the object in an unmistakable language.

In developing the intellectual faculties of mankind, beginning with the child, there is first the inception of an idea, derived from some form and an associated sound, expressing its name; this is followed by the repetition of the sound by the child, giving rise to vocal language which is developed in later years in the public school system of instruction by spelling and reading. Thus the first, or oral, division of language is cultivated, while the second, and more extensive in its range and application, the graphical, does not receive the attention which its importance deserves.

It is true that writing has long held an important place in our popular educational systems, and of late years drawing has also been introduced systematically, but as yet only so far as to cultivate the eye and hand in sketching outlines and shading, that is, in making pictures and elementary designs either for decorations or for the practice which such operations afford in estimating magnitude, distance and direction.

That important division of drawing which is the basis of the correct interpretation of all forms and magnitudes and is of the greatest practical importance to all artisans and many artists and professional men, is as yet entirely ignored.

I refer to a knowledge of elementary projections, without which a working drawing can neither be made nor understood, and the artisan destitute of it is obliged to acquire the practical knowledge for the successful application of his handicraft by long years of apprenticeship while he learns the uses of the various templates that may be placed in his hands by a master.

A moment's consideration will convince an observer that there are two methods of representing objects, viz.: 1st, as they *appear* to exist, constituting *perspective;* and 2d, as they *do* actually exist, as in *projections*, in which, relative position, form and magnitude are given. The perspective view is of little practical importance to the workman, as he is unable to obtain from it the data necessary to reproduce the object.

No two persons in an audience can see the same object from the same

point of view, and hence unless it be symmetrical with reference to a point in space, as a sphere, the line of apparent contour will be different to each. The magnitude will also appear larger or smaller according to the distance of the observer from the object. Thus, if a circular disk be held up before an assembly it will appear circular only to that person at the end of its axis, while to those in the plane of the disk it will appear to be a straight line, and to all others the ellipses of which the line and circle are the limits, thus verifying the aphorism of the poet Longfellow, when he says,

"And things are not what they seem."

With projections, however, the case is different, as, if understood at all, they can only convey one impression to the reader. But it must be confessed that they are no more intelligible without a knowledge of the principles upon which they were constructed than is a printed work to one ignorant of letters.

The principles of projections are, however, as simple as those of elementary geometry, upon which they are based, and can be readily comprehended by the pupils in our public schools. And a knowledge of these principles would enable many of them to work much more intelligently in the various trades in which they may thereafter become apprentices.

The application which may be made of such information is very extended. As a disciplinary study it is one of the first order, developing the conceptive faculties and enabling one to grasp an idea readily. It has its application in nearly all manufactured articles and in all constructions and designs, in wood, iron, stone, clay, or other materials. It is used constantly by the engineer, architect, builder, pattern-maker, iron or sheet metal-worker, stair-builder, stone-cutter, designer, and a host of others. It is the basis of all perspective drawings which are generally made by rule and without reason, and is essential to a correct interpretation of all suggestions relating to constructions of any kind. It is used to explain and reinforce verbal language, and should be so used whenever possible.

One of the most important applications of graphical language must not be overlooked. To the statistician as well as merchant it is valuable as furnishing at a glance information which if expressed in a mass of figures would be unintelligible. It cannot be surpassed as a method of exhibiting rapidly the distribution of population, of products, of poverty or wealth, of crime or morality, of vital, or in fact any statistics which may be expressed numerically. To the physicist it is also particularly useful in investigations into the properties of molecular or mass physics, and enables him to discover almost immediately the laws governing the motions of matter.

Fluctuations of prices, in the market values of daily commodities, may be more intelligently expressed by this means than any other and can be compared at a glance. In short, the number of intelligent and eminently practical applications that may be made of projections is almost limitless.

Its introduction would supplant a certain amount of mnemonical by rational and manual development, and would thus be a relief to a system already overtaxed with memorizing.

Another means of disseminating thought, as well as of developing the mental and manual faculties simultaneously, would be the introduction of type-setting in the public school as a weekly exercise, but as it is not the purpose of this article to discuss here the means and methods of industrial education, any further remarks on this head will be out of order.

It is merely intended to call attention to the fact that there is need of a more complete development of all the faculties used to convey or receive impressions and to coördinate them into a closer and more efficient system of instruction as a basis for the more intelligent expression of thought.

Stated Meeting, June 20, 1879.

Present, 5 members.

Vice-President, Mr. FRALEY, in the Chair.

A photograph of Mr. J. F. Mansfield, was received for insertion in the album.

Letters of acknowledgment were received from the Natural History Societies at Württemberg, April 1 (101, 102); Freiburg, Feb. 2 (101); the Societies at Harlem, Aug., 1877 (97, 98, 99); Lyons, Aug. 1, 1878 (I to XV); Edinburgh, Oct. 31, 1878 (100, Cat. III); the Royal Academy, at Amsterdam, Oct. 22, 1877 (100, Cat. III); New Hampshire Historical Society, June 16 (103); the Essex Institute (103); the U. S. Military Academy, at West Point (103); the New York Historical Society (103); the American Ethnological Society (103), and Astor Library (103); the Numismatic and Antiquarian Society (103), and Historical Society at Philadelphia (103); the Wisconsin Historical Society (103); and various members (103).

Letters of envoy were received from the Royal Academy, at Amsterdam, Feb. 7, 1879; Imperial Academy, at Vienna; Royal Academy, at Munich, April 10, 1879; Holland Society, Harlem, Dec., 1877; Government Surveyors, Victoria, Feb. 12; Greenwich Observatory, June 20; Meteorological Office; and Mrs. Sarah S. Pickering, May 19, 1879.

Donations for the Library were received from the Academies at Amsterdam, Bruxelles, Berlin, Vienna, Rome, and